The Computerworld Honors Program

CASE STUDY

ORGANIZATION:

Metro St. Louis

PROJECT NAME:

Predictive Monitoring

LOCATION:
St. Louis, Missouri, United States

YEAR:
2006

STATUS:
Laureate

CATEGORY:
Transportation

NOMINATING COMPANY:
Accenture

Summary

Metro St. Louis is pioneering public transit fleet maintenance through the use of Predictive Monitoring, a system of sensors, statistical analysis and online alerts that forecasts equipment failures. One of the nation's best-run regional transit systems, Metro St. Louis successfully tested the technology during a pilot launch, demonstrating Predictive Monitoring's ability to successfully monitor a vehicle's health, both red-flagging vehicle breakdowns before they occur and also optimizing maintenance schedules for well-performing vehicles. For public transit, the implications are dramatic: electronically relayed, real-time data can increase the dependability and life of the nation's bus fleets while reducing costs, and enhancing safety and customer service.

Introductory Overview

Metro St. Louis operates an interconnected transit system, carrying 46 million passengers in 2004 on its network of buses, light rail and vans for the disabled. Its largest operation, Metro Bus, includes 433 of the system's 600 vehicles, and transports 100,000 commuters a day.

Metro St. Louis wanted to reduce maintenance costs while improving vehicle reliability, a hallmark of its transit system. To achieve its dual goals, Metro St. Louis faced an unusual challenge: the highly regarded maintenance operation used tight maintenance schedules, which often meant unnecessary spending. Metro St. Louis needed to find the "sweet spot"—spend less on costly maintenance that forced vehicles out of service, while extending the life of its major assets, the buses. Monitoring technology, developed in partnership with Accenture Technology Labs, offered the solution. In January 2005, Metro St. Louis launched a six-month pilot that involved equipping 20 buses with sensors, which monitored 15 different engine and transmission performance indicators throughout the day.

The information was stored in data collection boxes installed on the buses, and then relayed via satellite to computers at Accenture Technology Labs in Chicago for statistical analysis. Lab computers, equipped with sophisticated predictive monitoring software, compared the bus's operational data with the analytic model that reflected "normal" operating behavior for that specific vehicle. The computers searched for anomalies in the bus's daily performance to spot potential

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problems, and once identified, the system automatically notified Metro St. Louis maintenance personnel via e-mails, pages or website alerts. Based on those alerts, the Metro maintenance team could review the equipment problem and potential impact, and then determine the best time to perform maintenance. The end result: mechanics can fix problems before equipment fails, while also allowing Metro St. Louis to optimize maintenance schedules for each bus in its fleet.

Benefits

After six months of data collection, Metro St. Louis declared the pilot launch a success based on its initial goals of reduced maintenance costs and increased vehicle dependability. The advanced information-sharing network fundamentally changed the way maintenance was performed, delivering both immediate and long-term benefits. When sensors detected an overheated hydraulic retarder, Metro addressed the minor issue before it became a major problem. "When a bus is failing, it can burn two to three times as much fuel as normal," explains Metro executive Tom Dutton. "If we can bring it in for repair early, we can save on fuel, which means a lot to an organization that buys an average of 14,000 gallons of diesel per day." Deploying Predictive Monitoring to the entire bus fleet will allow Metro St. Louis to fully harness the power of the groundbreaking technology.

In the long term, the revolutionary system has a direct impact on the bottom line, including:

• Extending the average life of the bus fleet through improved maintenance while lowering the cost of ownership by eight to 10 percent.

• Servicing vehicles based on each vehicle's individual need rather than on a preventative master schedule. This generates considerable cost savings over the life of the bus. Even one less transmission overhaul during the life of a bus means $6,000 in savings.

• Improving fuel usage. Buses not running at peak maintenance often burn more fuel. By pinpointing mechanical problems when they start impacting performance, the system saves money on both fuel usage and maintenance costs.

The end result: with the improved ability to control costs, the system has the potential to reduce the size of future fare hikes.

Metro St. Louis views Predictive Monitoring as a technology that can improve the means through which we maintain our fleets, optimizing maintenance. We also see that the results of optimized maintenance will also positively improve our inventory levels, related procurement activities, maintenance staffing, and other related activities. We are thrilled to be on the forefront of this predictive insights technology, which we believe will soon be prevalent throughout public transportation and many other aspects of our lives.

The Importance of Technology

Predictive Monitoring technology redefines the future of maintenance management of taxpayer-funded transit systems throughout the United States and around the world. Most equipment maintenance is conducted reactively, after a costly breakdown occurs, or routinely whether or not maintenance is needed. Instead of reacting to problems and making costly decisions based on guess work, the Predictive Monitoring system enables Metro St. Louis to manage on the

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offensive. By using real-time information relayed through the network of sensors, statistical analysis, and web-based alerts, management can quickly and accurately make proactive decisions that allow it to achieve the transit system's goal of providing highly reliable and cost-effective public transit service to riders. The system demonstrates the power of IT collaboration: Metro St. Louis worked closely with Accenture Technology Labs on the statistical modeling that would enable maintenance workers to diagnose problems before they occur. Once detected, the Labs used on-line notifications to alert the Metro St. Louis maintenance team, which could determine whether the problem required immediate attention, or whether the bus could remain in service and wait for routine maintenance.

A critical success factor was the use of SmartSignal's EPI Center software solution. SmartSignal provided the analytical engine that enabled Metro St. Louis to receive current, relevant and actionable alerts. Originally developed at the US Government's Argonne National Laboratory, it was later commercialized by SmartSignal. Orbcomm provided the satellite service that relayed sensor data from buses to Accenture Technology Labs. Finally, Quake Global provided an onboard device for sensor translation. The collaboration among the various IT partners resulted not only in a 21st century predictive monitoring solution, but a revolutionary maintenance system for cash-strapped public transit agencies.

Originality

Although Predictive Monitoring had been used successfully by the utility, airline and the chemical industries, this was the first such project in public transit history. Metro St. Louis wasn't afraid to think out of the box as it searched for a way to reduce maintenance costs and improve customer service. The progressive transit agency reached out to IT partners familiar with emerging technologies. When shown the Predictive Monitoring model, Metro St. Louis executives quickly recognized the advanced technology's potential to help identify when individual vehicles required maintenance. This new capability would prevent both unnecessary servicing of buses and serious mechanical failures. An additional benefit is that, with Predictive Monitoring, the agency could extend vehicle life by customizing, for each vehicle, the intervals between scheduled maintenance and overhauls. By performing maintenance only when needed, the life of the bus and parts can be extended, decreasing the overall cost of ownership.

If Metro St. Louis expands the pilot project to its entire bus fleet, the agency will realize the innovation's full capabilities. Predictive Monitoring can be integrated with other operational processes to improve bus dispatching, labor scheduling and parts inventory management. For riders, the real-time information can be used to provide online schedule and wait time updates. Other transit agencies are already considering implementing Metro St. Louis' innovative solution.

Success

Predictive Monitoring is allowing Metro St. Louis to achieve its stated mission: to enable "regional economic development through excellence in transportation." In public transportation, excellence is earned by providing a transit system that is reliable and affordable--Predictive Monitoring contributes to both. The state-of-the-art system supplies the real-time data and analysis that allows the transit system to find the "sweet spot" between costly maintenance and extending the life of its vehicles. The maintenance team can weigh service disruptions against

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the costs of a minor problem escalating into a much more expensive repair. With the electronically based Predictive Monitoring system, bus service suffers fewer disruptions because vehicles are not taken off the street for unnecessary or unplanned maintenance, and the transit agency saves on maintenance costs.

For the nation's publicly funded transit agencies the implications are enormous. Maintenance spending is a critical problem for the nation's public transit systems, especially at a time of spiraling fuel costs. In 2003, publicly funded public transit agencies spent over 36 million hours performing routine bus maintenance. At a time of budget cuts and soaring fuel costs, Metro St. Louis' Predictive Monitoring solution equips public transit with powerful new tools for balancing the often competing needs for savings with optimal fleet maintenance. The real winners are riders who depend on cost-effective public transit for their daily commutes. By improving service, mass transit systems have the opportunity to lure commuters out of cars and into buses—helping improving traffic situations.

The purpose of the Predictive Monitoring pilot, which we successfully proved, was to show that the various technology components work together in public transportation. The pilot also provided us with information to monitor vehicle health and optimize maintenance activities and costs.

While our preventative maintenance program and the pilot schedule kept us from anticipating or identifying any upcoming failures during the pilot, we did indeed identify an upcoming failure toward the end of the pilot.

Identifying this failure, and proving to ourselves that we can perform anticipated maintenance optimization improvements, has led us to our current efforts in which we are planning how to deploy this technology to our entire MetroBus fleet.

People throughout our Operations organization are excited about this technology, including one of our Garage Superintendents who has said that "this [Predictive Monitoring] is the best thing ever". Our Chief Maintenance Officer has noted that Predictive Monitoring technology is "clearly the wave of the future."

Both our Operations group and the supporting IT group are very supportive of our use and deployment of this technology. We definitely see Predictive Monitoring as the future of fleet maintenance and are pleased to have been the initial transit agency to use the technology. We anticipate our initial fleet deployment to take place in 2006-2007.

Difficulty

The Metro St. Louis Predictive Monitoring system represents an innovative solution to a challenging problem. Among the greatest difficulties: creating a "snapshot" of how each bus performs under normal operating conditions. Metro St. Louis and Accenture researchers developed a single starting model that was modified to create an individual statistical model for each bus. This similarity-based modeling technique used in Predictive Monitoring can forecast failure more accurately than standard analytic methods because it monitors machines under varying, real-life conditions. Taking the variable factors--such as bus length, vehicle age and recent maintenance—into account, the range of what is considered healthy can be reduced, helping managers detect much sooner when a failure is on the way.

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Metro St. Louis appreciated the potential benefits when Accenture proposed the pilot to us and we welcomed the opportunity to explore how the innovative Predictive Monitoring solution could help us. We did not experience funding issues for the pilot. We are discussing a fleet-wide deployment thanks to the proven benefits and are working through the financial details of such a deployment.